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ABSTRACT

When designing educational resources, it is important to have a clear understanding of the instructional problem you are attempting to solve, both in terms of its appropriate domain and level. While the cognitive, affective, and psychomotor domains are not mutually exclusive, one will usually predominate. In determining the appropriate level, it is important to remember that to reach a given level it is necessary to pass through all subordinate levels. Levels are: (1) definitions, (2) component recognition and location, (3) awareness of purpose, (4) components of usage, (5) awareness of sequences, (6) application, and (7) discrimination and extrapolation. (STS)

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THE DESIGN AND DEVELOPMENT OF EDUCATIONAL RESOURCES

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THE DESIGN AND DEVELOPMENT OF EDUCATIONAL RESOURCES

I offer this paper as a rationale and a prescription. The prescription is not unique, nor has it been copied or plagiarised from other work. These thoughts are an accumulation of twelve years work in the field of actually having to provide resources and devise a positive means not only by which they can be designed but by which they can be evaluated afterwards.

An essential component of any rationale is a strategy, and the strategy I have adopted here is simply one of investigating the customer in terms of his requirements in the beginning and conducting the evaluative and final process under exactly the same terms and conditions.

The prescription which was devised is only applied to the middle section of developing the resource once it is known clearly for what it is required. The three domains proposed by Bloom and others being the cognitive, psychomotor and affective domain were once considered to be discrete. I, like others, do not think this is so,[1] I believe they inter-relate and that no communication can exist (except perhaps E.S.P.) without containing a component of all three domains. Illustrated by Venn diagrams the domains look like:

Figure 1

The size of each domain, however, is completely dependent upon what is being communicated, or what is occurring.

For example, when devising a package to support an Education Programme of instruction in jumping or vaulting an obstacle, then this would be principally psychomotor domain. However, the size of the obstacle involved would influence the whole activity into the affective domain as would the knowledge of exactly how to do it imply some cognition being required.

Even heavily cognitively oriented subjects, such as mathematics, cannot be expressed or communicated without entering the psychomotor domain of writing on paper, or actually speaking out loud.

I therefore begin by underlining the need to thoroughly investigate what the problem is in terms of the three domains, and an attempt to establish which of those domains holds the primary role. This then leads me to my first main supposition. Should there be a heavy affective domain component in what is being undertaken, then I submit that no direct interaction can occur, and the affect can only occur in a planned way as a secondary component to the comprehension of the communication.

I mean by this that if we communicate some fact or teach some skill which will have a resultant effect in the affective domain, that effect will only be measurable in terms of cognition or a skill.

As yet we do not understand (and in my opinion have no immediate likelihood of understanding) how to directly communicate in the affective domain. For example, should an attitude of not smoking be required to be communicated to a class, it would be reasonable, (following research evidence showing that those who knew the long term effect of smoking were less likely to smoke) to devise a communication which teaches the long term effects of smoking as a cogniture awareness.

This would be evaluated in terms of those pupils that knew the long term effects of smoking. The secondary effect that it would have, hopefully in the long term of stopping them smoking is not being directly measured. The attitude introduced by the communication of some cognitive facts is all that really should concern the material developer in the first instance.

Once one is very clear as to the content of the communication required, then a little time must be spent on discovering how difficult the route is likely to be[2]. Bloom et al and many other agencies have developed taxonomies. Bloom's taxonomy remains firmly respected by all and is a very clear and concise development in the science of communication or Educational Technology. The objectives can be couched in terms such as Bloom expounds but one must hasten to add that all this was intended to do was to describe the difficulty of the operation or the actual objective. Humrro also offers some assistance here in terms of three generalised areas suggesting that all communication still can be summarised into one of three headings: relating, discriminating or generalising.

It is with these in mind, knowing the domain in which we should be operating, and the difficulty of the route, that the prime task of this paper is to design a route description as a prescriptive method of achieving that route.

The fundamental rationale of this process is a description of a route in terms of levels of knowledge and skill. If the final objective is couched in terms of one of these levels, all the rationale proposes is that every one of the lower levels must have been passed in some order and, hopefully, sequentially.

The method could be described as a linear algorithm and yet, because of the nature of the prescription, the route between the milestones may vary according to the user's wish.

The seven levels as originally described were for the training of sailors in the Royal Navy to operate sonar sets.[3] Therefore, the terminology was heavily couched in terms of switch and machine operations. However, the whole process has now been expanded to satisfy wider and more generalised educational requirements.

In the development of a resource, there comes a time when a decision has to be made in order for something to be produced. That production decision can be made intuitively, whereby the designer's past experience will be used naturally and will play an important role in the format or direction that is chosen for the resource production.

Many algorithms exist which will also assist production in these areas. Romiszowski particularly offers some useful and original suggestions. Unfortunately, although the algorithm may have been based on sound structure and built rationally, that structure and decision-making process is not available to the user and he is constrained to the algorithmic process alone.

In simple terms, when designing or approaching any sequential event, in addition to knowledge of the objective, a skeleton route would be of immense value to a design team.

It was with this in mind that my seven levels of structure are to be considered as seven points on the route to a terminal objective. Whether this terminal objective is in a classroom or a produced package does not matter. It is essential to the concept of this argument, however, with whatever method is chosen, that the seven components (or some lesser number depending on the level required) are all present to the level of the component required.

The seven levels are:

1. Jargon/Definitions
2. Component Recognition and Location
3. Awareness of Purpose or Usage
4. Components of Usage or Skill
5. Awareness of Sequences or Relationships
6. Skill Performance or Application of Relationships
7. Extrapolation - Start and Finish Discrimination

In more detail covering each level separately:

1. Jargon and Definitions
   This level of understanding is of terminology only. It is the level of requirement where a knowledge of a word or 'O.K.' phrase is present without accompanying awareness of its meaning or relationships. Perhaps many politicians would understand!

2. Component Recognition and Location
   The components referred to are not necessarily physical, they could be conceptual. It is really a recognition of the meaning of the jargon to the presentation. The next level, involving locating a concept or component, implies looking for it, which is a higher level skill than recognising it when presented to you. This is the kind of level required of an apprentice in his first week or a student at his first lectures, both being presented with all the many components that the lecturer will be dealing with at a later stage. Eventually the lecturer will expect the early components to be recognised and found without prompting.

3. Awareness of Purpose or Usage
   This, as an addition to recognising components, becomes a level in the affective domain (prior to Level 4 which is practical) whereby the component's purpose in the whole is realised. Since this is an awareness component, it would very seldom validly be a terminal objective other than in situations where someone else takes on Level 4 in the training or education programme.

4. Components of Usage or Skill
This is the achievement or practice of the concept or skill component or particular component out of context to its normal situation. It is the kind of component that varies enormously from student to student and the methods of dealing with it similarly vary from teacher to teacher and trainer to trainer. It is very clearly a psychomotor terminal objective which will be always present in any programme, whether or not higher levels are to be considered. Typical of this level would be: the use of a word in a sentence; the use of a specific algebraic process such as the addition of indices; the performance of a particular trade skill such as drilling a hole. It should be emphasised that at Level 4 the skill performed is out of context, whether an application of a concept component or a physical action is being considered; the related components should not be allowed to confuse the issue.

5. Awareness of Sequences or Relationships
This is the level at which the relationship of the components which have been dealt with in Level 4 are dealt with in theory in order that they may be put together in Level 6, to perform the complete sequence of skills It is necessary to clearly establish at this level whether or not the skill sequence will be learnt by heart, will be directed step by step by a supervisor, or will be cued by some form of check list.

6. The Performance of Skill or the Application of Relationships
This is where the final skill is most likely to be completed to the level of guidance outlined above. This guidance in the terminal skill can therefore be in this simple form, and the direction is definitely stated (e.g. as is required at some stage by a student of parachute jumping, or in a more academic situation when a lecturer finally presents his thesis to a class).

7. Start and Finish Discrimination and Extrapolation
This situation is really a review of the whole process, expanding the awareness and ability to a judgement level such as is required by the person receiving training or education in order to teach others. In most cases if this level of training is required, it will be achieved by practice of the skill and subsequent discussion and review of the activity.

These seven levels provide the skeleton framework on which to base any design or presentation. If the skill is needed to reach any level, it is vitally necessary to have passed through all of the subordinate levels or it is questionable whether or not the skill can be achieved.

The treatment should not be confused with Blooms' Taxonomy, which really defines levels of cognition which would be present to a greater or lesser extent on each of the levels of treatment outlined above. One is really saying, to draw an analogy, that in the route of presentation up to seven points are definitive in achieving a terminal objective, but the difficulty of the road through each point would depend on the subject being treated. Blooms' taxonomy really defines route difficulty whereas the seven levels give some indication of the route.

I offer this treatment as a means to an end in the hope that others may find it useful not only in talking about their intentions but hopefully to assist them in achieving them.

If the problem is now analysed in terms of the seven levels we can begin to look at the levels themselves as offering some form of solution to the final mediation.

Figure 2

Levels one, two and three, dealing with components will inevitably be component resources. Level four being a natural skill in its own right, albeit out of context, will be practised using realia, or actually in the classroom.

Level five begins to present an awareness of a sequence of skills or a relationship between concepts. This awareness of the fact of a skill's existence will be mainly in the affective domain and can be presented with what one could call a complete media such as film, tape/slide or even the teacher himself. Finally, levels six and seven are the levels dealing with the complete skill performance and its perfection. The level of skill performance may involve cue cards depending on what level at which the skill is being performed, and a statement showing whether the skill is to be performed under direction, under supervision or without any direction whatsoever.

Level seven itself is really a situation from which a perfection of performance of level six can emanate.

Levels 6 and 7	- Cue cards, references, (realia).
Level 5	- Film, Tape slide, (complete exposition).
Level 4	- Usually Realia/Classroom.
Levels 1, 2 and 3	- Component resources.

It is at this stage that one sees an enormous difference between levels one, two, three and the remainder. Levels one, two and three must be included by whoever deals with the whole topic. These components are the 'core', they are the very 'essence' of the whole subject. If materials can be manufactured supporting these core components, then surely they will be used by all, whether they be teachers or students. The great advantage that ensues is illustrated by the next diagram which shows clearly that if level one, two and three are dealt with they can be reproduced and used flexibly by many people in many ways.

Figure 3

This was the rationale behind the development of resources at the Educational Technology Centre of the Education Department, South Australia. In that Centre some flexible resources were produced which are not structured to produce a total skill. All the advantages are then included that tend to the left hand side of the objective continuum illustrated in the diagram.

Figure 4

This continuum clearly shows the end at which a mass media organisation should be concentrating, bearing in mind that cost-effectiveness is not just a simple example of whether it works: whether it will be used is probably even more important.

The availability, acceptability and awareness of a media solution is just as important as to the success level that it achieves in relation to the problem.

Figure 5

If it is not available or acceptable, it just won't be used: if it can't be understood, more problems will generate. If component resources are flexible resources, they will be used in large quantities by more people and play the major component in the cost exercise.

Our solution to this was in the form of a Pic-a-Pak. The Pic-a-Pak Resource Material is designed to be as flexible as possible; it is unstructured, unsequenced, but always based on a given topic. "Designed to be used as support material, background material or even just as a collection of raw resource material, based on a specific subject, which could be of assistance in the preparation of lessons or projects".

Our methods of production enable us to sell Pic-a-Paks at a very low price and schools may wish to buy multiple copies, experimenting with the sets and perhaps making packages to meet specific needs within their schools or simply as part of a resource bank. We don't mount the slides because the cost to users would soar. Purchasers can mount all the pictures or just those they wish to use. The unmounted slides are protected by the plastic container.

The Pic-a-Pak may contain a set of colour transparencies or a set of colour photographs (or a combination); it may even be related to an audio tape; it may contain supportive material; it ALWAYS contains two copies of the black and while reference sheet.

Requests for Pic-a-Paks come via the curriculum committees; these committees also validate the content of the slides and approve the collection prior to them being issued.

The Pic-a-Pak format has been proved as most useful, not only as a catch phrase but in actual use by many people. We think it is the bridge between a theory and a practice, and judging by its sales and acceptability we are well on the way to proving this issue.

The greatest single danger of this whole issue is perhaps that so ably illustrated by Schultz in his Peanuts cartoon in that if we are not very careful our media type could very soon end up down the sewer if we know too much about media and stop just flying kites.

Figure 6

Figure 7

REFERENCES

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2 BLOOM, B.S., ed. et al. *Taxonomy of Educational Objectives: Cognitive Domain.* New York: David McKay Company, Inc., 1956. Describes the cognitive categories in detail and presents illustrative objectives and test items for each.

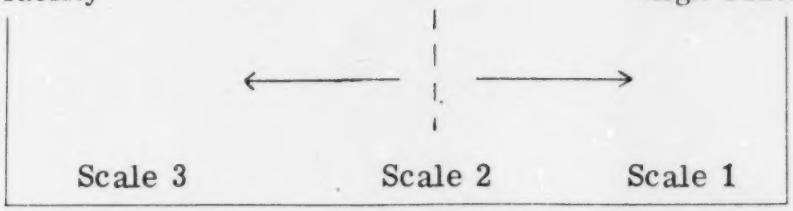
KRATHWOHL, D.R., et al. *Taxonomy of Educational Objectives: Affective Domain.* New York: David McKay Company, Inc., 1964. Describes the affective categories in detail and presents illustrative objectives and test items for each.

3 DUNNETT, C.W. (1970b) "Development of a Training Module from an Objective Task Analysis", *Journal of the Royal Naval Scientific Service*, 25, No. 5.

FIGURE 4

OBJECTIVE CONTINUUM

Long Term	Short Term
Wide Range	Narrow Range
Theory-Orientated	Operationally-Orientated
Low Fidelity	High Fidelity



SCALE 1 Objectives - Statements of Operational Performance, to operational standards, in operational conditions.

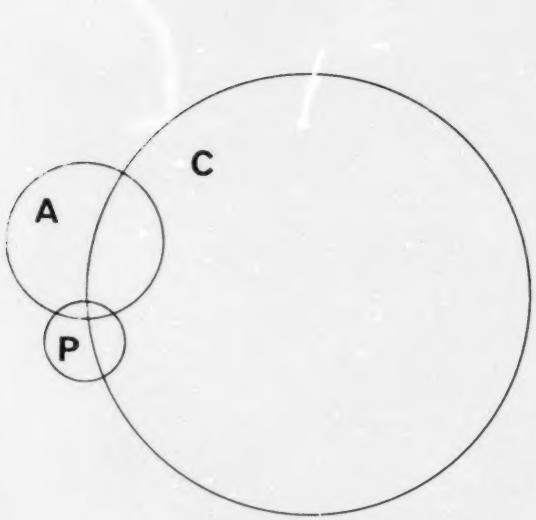
SCALE 2 Objectives - Statements of Performance which forms part of the operational requirement, with conditions and standards lower than required in the operational environment.

SCALE 3 Objectives - Statement of supporting performance, theory orientated, with imposed conditions and standards as academic discipline.

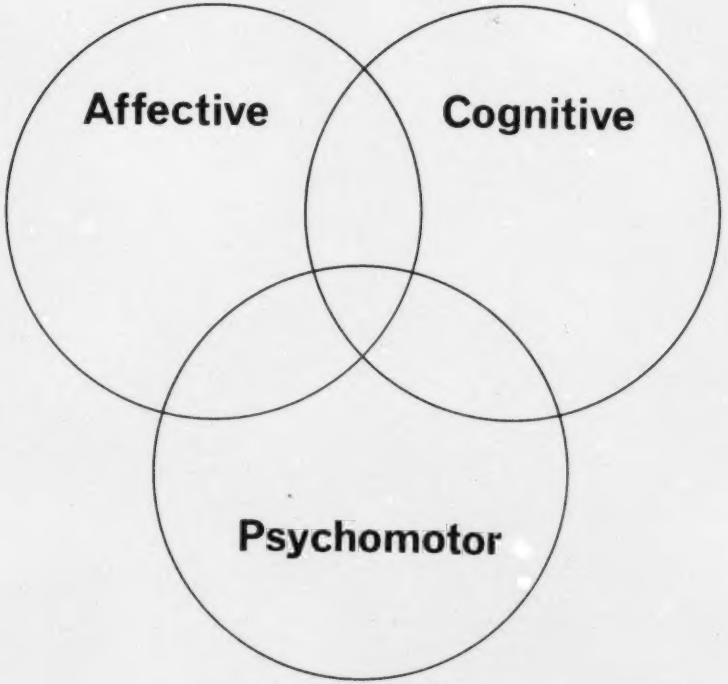
FIGURE 6

PEANUTS
IN KITE-FLYING THE RATIO OF WEIGHT TO SAIL-AREA IS VERY IMPORTANT
YOU KNOW A LOT ABOUT KITES, DON'T YOU, CHARLIE BROWN?
YES, I THINK I CAN SAY THAT I DO...
THIS RATIO IS KNOWN AS "SAIL LOADING" AND IT IS MEASURED IN OUNCES PER SQUARE FOOT. FOR EXAMPLE, A THREE-FOOT FLAT KITE WITH A SAIL AREA OF FOUR AND ONE-HALF SQUARE FEET SHOULD WEIGH ABOUT TWO OR THREE OUNCES...
THEN WHY IS YOUR KITE DOWN THE SEWER?
SCHULZ

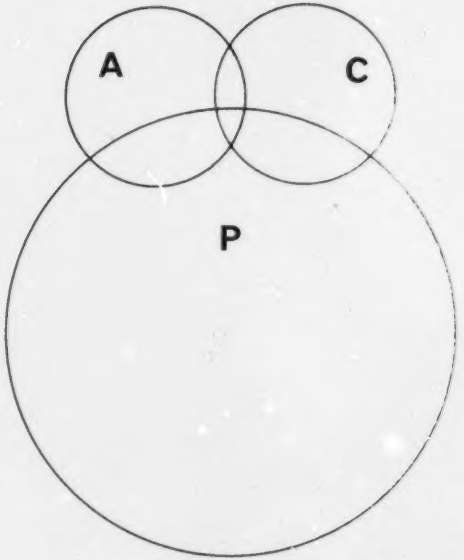
FIGURE 1



(a)



(b)



(c)

FIGURE 7

Theory Practical application

FIGURE 2

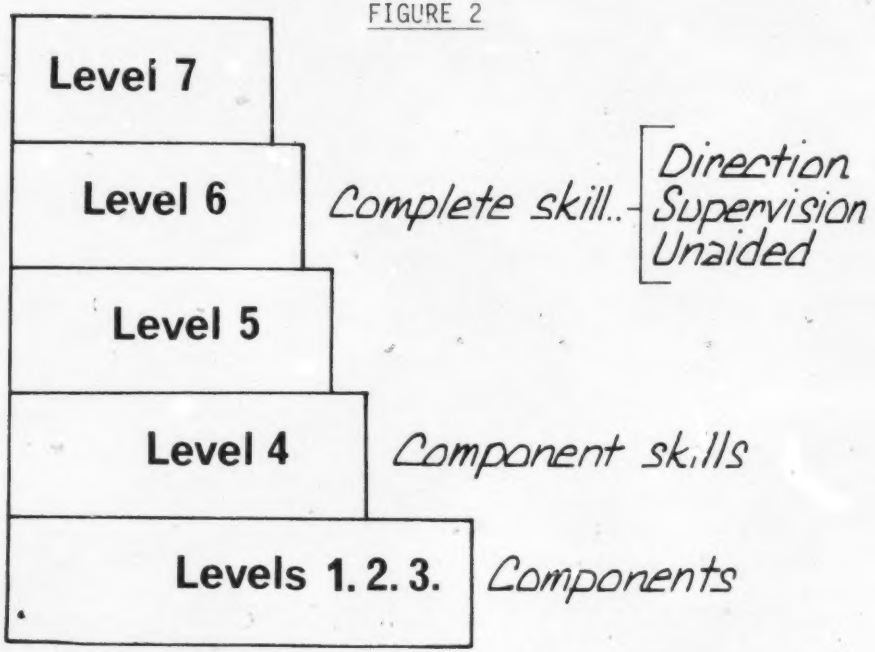


FIGURE 3

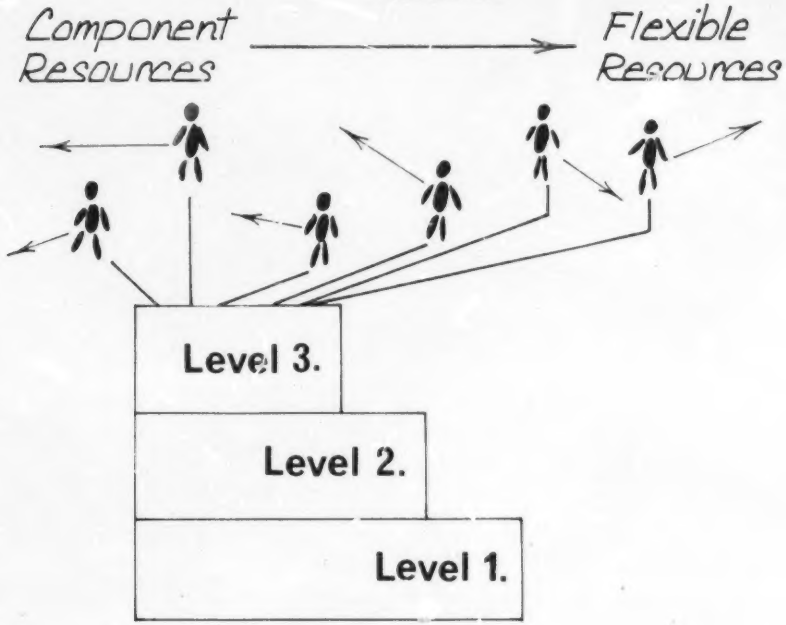


FIGURE 5